White Paper for NEH Digital Humanities Start-up
2017 May
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HD-228866-15: Comparative Ethnobiology in Mesoamerica: A Digital Portal for Collaborative Research and Public Dissemination

0. Clarification

The semi-annual report submitted October 2016 was very close to a final report. The project was not closed out in October simply because of the need to iron out a few bugs in the web interface and the fact that final payment to the programmers was conditioned on finalizing the deliverables. This was accomplished in January 2017 and the project effectively concluded at that time.

1. Introduction and overview

"Comparative Ethnobiology in Mesoamerica: A Digital Portal for Collaborative Research and Public Dissemination" represents the first step in establishing a digital portal, hosted at Gettysburg College, for multidisciplinary and multiethnic collaboration on Mesoamerican ethnobiology: **DEMCA**: **D**ocumenting **E**thnobiology of **M**exico and **C**entral **A**merica (demca.sites.gettysburg.edu). Figure 1 is a screenshot of the home page in its most recent iteration. The major design and functional aspects of the website are described below. A Level II Digital Humanities Advancement grant is being prepared for June 2017 submission for funding to develop a more robust ethnobiological database and fully establish the interactive capabilities of the data portal that will join together, in a web-based project-based approach to (ethno)biological research, several groups of stakeholders, which can be considered in three major groups:

(1) Indigenous communities, researchers, and consultants;
(2) linguists and anthropologists working on the language and culture of specific native-language communities;
(3) biologists, particularly taxonomists, interested in both systematic and biodiversity studies for which specimens and verified occurrence data is important.

The web portal will, therefore, not simply be a mechanism for storing and discovering (ethno)biological information, including the functionalities of generating reports, field guides, and checklists. It will become an interactive portal for dynamic collaboration among the aforementioned stakeholders and provide the opportunity for continual commentary and feedback among users (stakeholders and the general public) who can annotate the data and create derivative content by establishing suggested links among the biological and, particularly, ethnobiological data.

To test the Symbiota-based functionality of the DEMCA web portal Amith uploaded the botanical metadata for approximately 2000 collections (e.g., geographic reference points, descriptions of vegetation and habitat, descriptions of the plant and, when applicable, flower or fruit). All search capabilities were functional as well as other features of Symbiota. In addition, Amith and his collaborators created a data structure (see wire frames below) for the incorporation of ethnobiological information, information that will be distributed across several tables (Consultant; Community/Village; Language; Vernacular name) in a relational database. Finally, the team designed a way (still not operational at this Level I effort) in which ethnobiological data in the relational database would be added to specimen (or observation) records of flora and fauna: see fig. 6 for how access to a dashboard for ethnobiological data will be integrated into DEMCA and fig. 6 for how the specimen record data entry form will be appended to allow for integration of ethnobiological metadata.

Figure 1: DEMCA Home Page (screenshot)

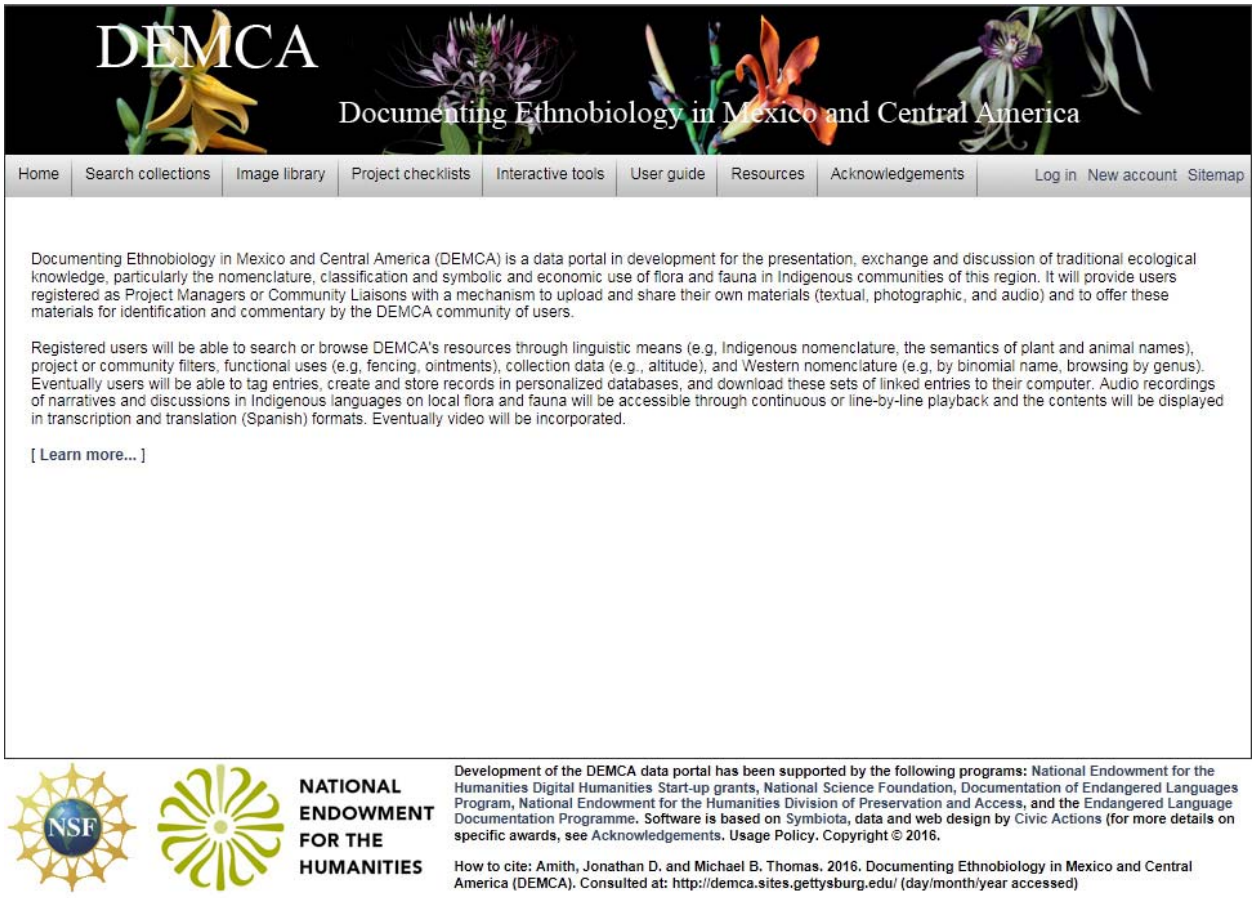


Fig. 1 is a screenshot of the DEMCA homepage. It has some utilities (e.g,. a User guide tab) that are not present on all Symbiota-driven web portals. But basically it offers the advantages built into Symbiota software (e.g, advanced searching across metadata fields, mapping, standardization of plant terms, a thesaurus of plant name synonyms, standardization of geographical toponyms). Although some tweaks will be necessary, Level I effort effectively produced a robust system for capturing, discovering, and displaying specimen-based botanical information. It is this basic information onto which ethnobiological data can be attached. DEMCA represents four important characteristics that are not available in other (ethno)biological online sites.

First, it will develop a highly structured and extensible XML schema for tagging of ethnobiological data. Eventually some of the elements will be proposed to the Darwin Core standard, a standard that facilitates the exchange of biological information but that has virtually no well-developed support for associated ethnobiological information. It is not an exaggeration to note that there is no extant project (https://www.idigbio.org/portal; http://eol.org/; http://www.gbif.org/) that even approaches adequate handling of ethnobiological data. DEMCA will begin to address issues that must be considered in handling such information both for research and dissemination purposes [see section 3 below]

Second, DEMCA will be project based and open to "deposits" from both researchers and communities that wish to document ethnobiological knowledge in Mexico and Central America (the geographic focus of the DEMCA site, although the software will be open source and could easily be implemented in other regionally focused portals). Plans are to seek a Level II grant that will allow the viewing and manipulation of this information by academics and the general public (Indigenous and non-Indigenous). Discovery and export will include the creation of checklists and community-specific illustrate field guides, links to audio-visual material, extensive cross-cutting webs of association linking ethnobiological information such as cognate forms in distinct though genetically related

languages spoken in communities dispersed over a wide geographical area, and similar cross-cutting webs of association among calques (loan translations) used in unrelated languages and that therefore indicate some degree of cultural contact and sharing.

Third, it will present Indigenous peoples talking about the flora and fauna with which they are familiar. Thus it will add an important multimedia linguistic and cultural component to the presentation of traditional ecological knowledge. Examples of this type of information can be viewed at http://www.balsas-nahuatl.org/audio-playback/01 (audio file with line-by-line playback of a Nahuat transcription [translation will be added in a Level II effort]) and at http://www.vimeo.org/xxxx [video about material cultural production using local plant resources]).

Finally, rather than simply a repository for the display and dissemination of (ethno)biological data, particularly traditional ecological knowledge of Indigenous communities, DEMCA will provide an interactive workspace for collaboration, research, and project development among a wide range of potential stakeholders, mentioned above in general terms. A more specific list is the following:

1. Academic scholars, including Indigenous scholars, researching traditional ecological knowledge of native communities
2. Native communities interested in documenting the nomenclature, classification, and use of the flora and fauna of their lands
3. Linguists and anthropologists interested in the aforementioned material, particularly nomenclature and classification of the biosemantic lexicon of Indigenous communities
4. Biologists interested in the flora and fauna of Mexico and Central America, particularly that located within Indigenous communities
5. The general public interested not only in the aforementioned (ethno)biological information but in the possibility of communication with the other stakeholders mentioned above.

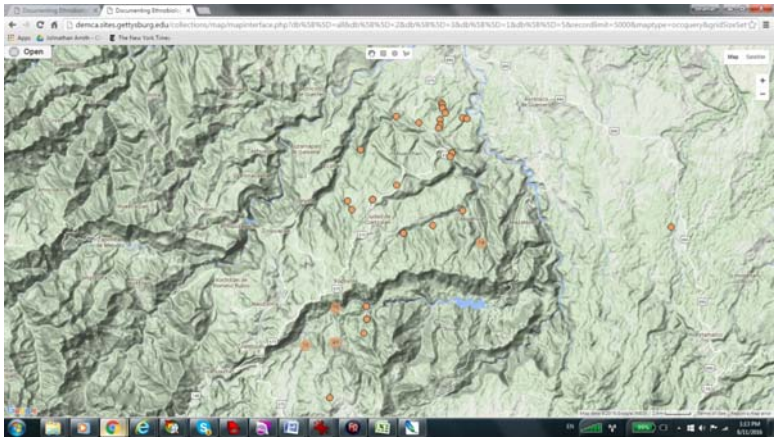
[see section 6 below]

2. Summary of advances up the beginning of the present reporting period.

The October report described the installation of Symbiota software on the Gettysburg College website under the name of DEMCA: **D**ocumenting the **E**thnobiology of **M**exico and **C**entral **A**merica, completed by June 2016. Between June and October 2016, the installation was properly tested on ethnobiological material that with funding from the National Science Foundation, Documenting Endangered Languages; the National Endowment for the Humanities, Preservation and Access; the Endangered Language Documentation Programme, School of Oriental and African Studies (London); and the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO, Mexico) Amith and several colleagues had developed.

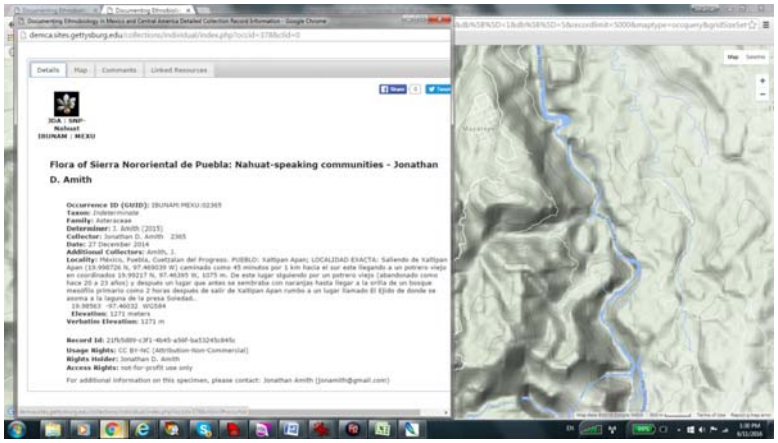
Although extremely robust for the storage, manipulation, and display of specimen-based data with the metadata expected in biological collections, Symbiota (as well as Darwin Core, the basic standard for mark-up of biological data that Symbiota uses) is quite impoverished in regard to any potential traditional ecological knowledge that is associated with a collected specimen. Some basic functionalities from Symbiota of the DEMCA web portal can be viewed in the screenshot below (figure 2), which displays the mapping of a search on specimen records in the Asteraceae (Sunflower) family. More complicated or specific searches can be generated and mapped, using almost any combination of the metadata captured in the MySQL tables.

Figure 2: Asteraceae Collected in Six Months of Field Work (2014)



Further details on the mapping function are presented in the previous report, including the possibility of clicking on any dot (collection location) and displaying the relevant collection data (see fig. 3)

Fig. 3: Collection Data Pop-up for Amith Col. #2365



Searches may also be limited to those records that have any number of types of associated data. Thus Symbiota allows one to search, for example, for all specimen records of the family Lamiaceae that have photos. Fig. 4 shows how searches are limited to records with photos. Such a search, limited to the Lamiaceae family, found the recording in fig. 5, the only Lamiaceae record that, as of now, has associated images (images were loaded as a test case). DEMCA will also present Indigenous peoples talking about the flora and fauna with which they are familiar. Thus it will add an important multimedia linguistic and cultural component to the presentation of traditional ecological knowledge. Amith and colleague researchers have recorded hundreds of hours of Indigenous language material on flora, fauna, material culture, food preparation, hunting and fishing, foraging and other topics related to the use of natural resources in native communities. With a Level II grant it will be possible to limit searches to specimen records with associated audio or video files (to do this lines will be added below _ Limit to documents with images only, to present the options _ Limit to documents with audio files only; _ Limit to documents with video files only). Thus a user will be able to search for all species collected in a given community that have

associated audio recordings. Moreover, once a user reaches a specimen record page (fig. 5), he or she will have the possibility (shaded circles in the fig. 5 screenshot) to link to audio or video files.

Figure 4: Limiting searches to specimens with associated images (shaded portion allows limiting feature)

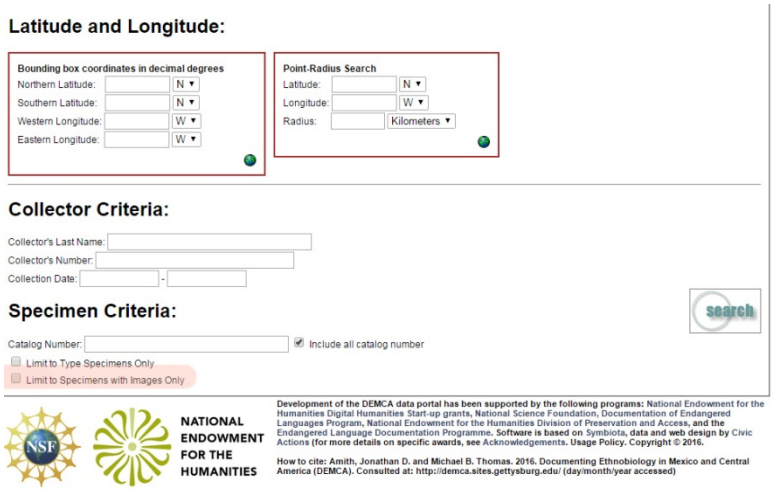
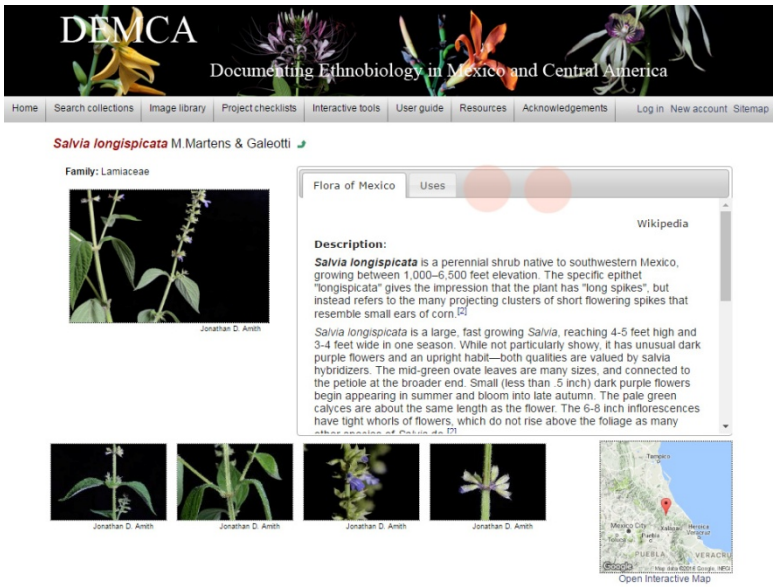


Figure 5: Creating tabs for links to audio and video in specimen records
(Colored circles represent places were tabs will be created for links to audio and visual documentation of the plant species)



For example, record entries for *Odontonema callistachyum* (Schltdl. & Cham.) Kuntze (Acanthaceae; *kwa:kwalakakowit* in Nahuat) will link to a page such as (http://www.balsas-nahuatl.org/audio-playback/01/). This is a provisional representation as the final presentation, hopefully to be developed with Level II funding, would have two enhancements: (a) continuous playback in addition to the present line-by-line playback; (b) parallel texts with translation to Spanish. In regard to video, record entries for *Guazuma ulmifolia* Lam. (*i3tun4 ti1nu'4u4* in Yoloxóchitl Mixtec, *olo:kowit* in Sierra Nororiental de Puebla Nahuat, *kwao:lo:t* in central Guerrero Nahuatl) will provide a dynamic link to https://vimeo.com/209600990, which shows a young Mixtec-speaking man from Yoloxóchitl making a top from the wood of the *Guazuma ulmifolia* tree. Or a relevant fern entry (species identification still pending) will link to the ritual documented in https://vimeo.com/193421429.

It may well be the case that as DEMCA develops into a multimedia presentation of traditional ecological knowledge the audio and video component will prove to be extremely attractive not only to the lay community and biologists but particularly to native communities as well as the anthropologists and linguists who study the relevant languages and cultures.

3. Development of a highly structured and extensible XML schema for tagging of ethnobiological data

There are many challenging aspects to creating a database for primary ethnobiological information that is directly linked to specimen collection and observation. After consultation with colleagues and programmers, Amith decided to parse out several types of information in a relational database. That is, the ingestion of ethnobiological data associated with a collected specimen will undergo the steps noted below, through which data is entered into four tables. All of these have been already been designed and placed on the DEMCA website. A future grant, however, will be needed to fully integrate and operationalize the structure.

3a. Incorporation of ethnobiological data: To accommodate ethnobiological data entry, the Data Editor Control Panel has been modified (Fig. 6: text for ethnobiological data entry in colored circle, which contains "clickable" links to data entry forms) so as to allow direct access to three of four tables: Consultant, Vernacular Name, and Village/Community. A fourth table, Language, has been added although at present this table is only accessible through the other three tables. This will be changed to allow direct access to the Language data table from the Data Editor Control Panel. Users will be able to access and populate these four tables directly from the Data Editor Control Panel (fig. 6) or they may enter specimen records and access the tables as needed (see fig. 8; the topic section is the standard Symbiota botanical entry form whereas the bottom section is the ethnobiological data entry form. In many cases (e.g., Consultant code, language, village, Indigenous name) data entered though the specimen record is part of a controlled vocabulary gradually built up through entries in the four basic ethnobiological tables: (a) consultant, (b) village/community, (c) language, and (d) vernacular name. For example, Village name is standardized and a depositor can only enter a name that is part of a geographic reference table (Symbiota has a table built in but DEMCA will also allow for additional geographic names to be added as needed.) Most often at the beginning of an ethnobiological research or community-based project basic information will be entered into the Consultant, Village, and Language tables. More than likely information will be entered into the Vernacular name table as collections are made and named by local consultants. Their purpose is to create a controlled though extensible vocabulary for each "topic" of ethnobiological data. The relationships among the distinct tables is illustrated in figure 7.

Figure 6: The new Data Editor Control Panel with Links for the Input of Ethnobiological Data (screenshot)

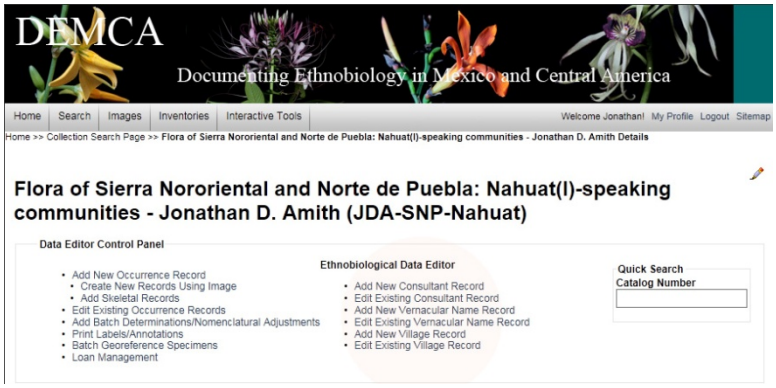
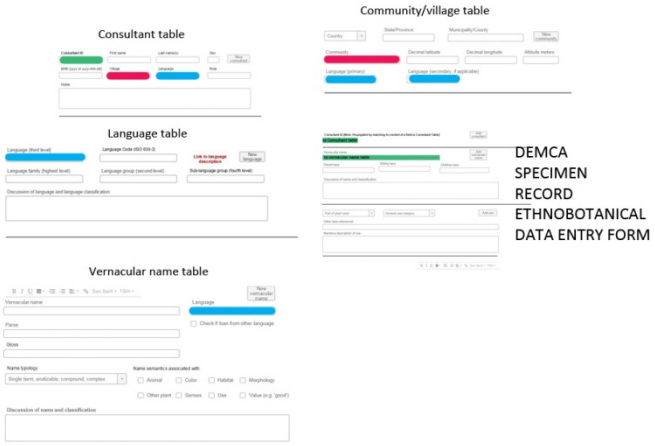


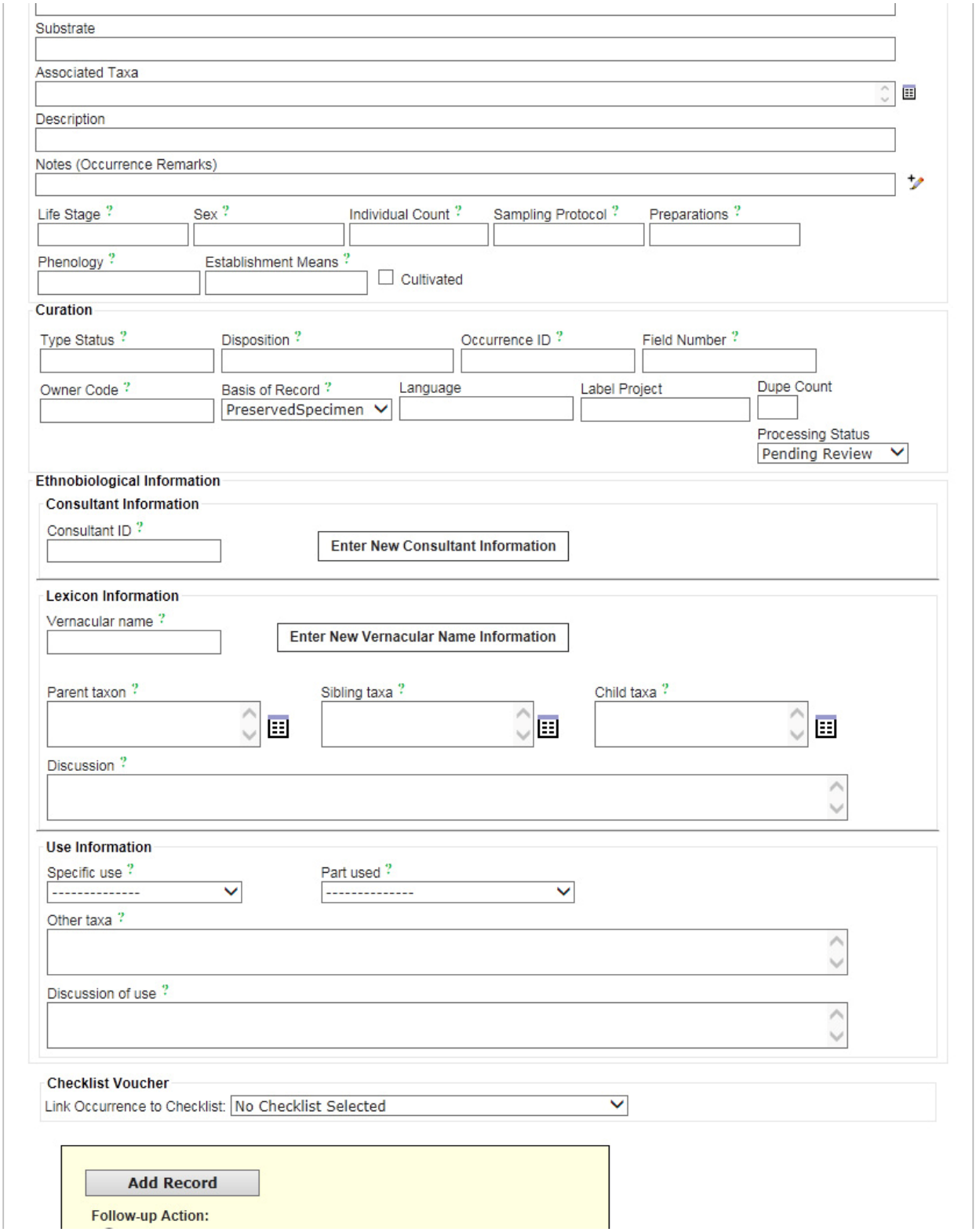
Figure 7: Schematic Representation of Data Structure for Ethnobiological Information



As the above sketch (fig. 7) indicates, the DEMCA specimen record data entry form has two items (in green in the above sketch, fig. 7) that establish links to two other tables: Consultant ID and Vernacular Name. In field research ethnobiological information is added to a specimen record (observance), just as information on geography (locality, coordinates, altitude), ecology (habitat) and morphology (plant size, color, and other characteristics), is added to a specimen record. The ethnobiological information, however, is more complicated. To begin with, it may often be a one-to-many relationship. That is, at the time a given specimen is collected, one or more native speaking consultants may be present and give information. They may have no name for the collected specimen, or they may have several. They may have no use for the collected specimen, or they may have several. Thus the relationship of specimen to Consultant is often one-to-many: several consultants may be present at any one collection event. Likewise, the relationship of Consultant to Indigenous nomenclature, classification, and use is also potentially many-to-one: A consultant might know several uses for a single plant, or either use or be aware of several equivalent names.. The ethnobiological data structure of DEMCA allows for these multiple one-to-many relationships

The following page (figure 8) shows the form for entering ethnobiological data to a specimen record in DEMCA. After page 8, there is a table-by-table discussion of the preliminary data structure for ethnobiological information.

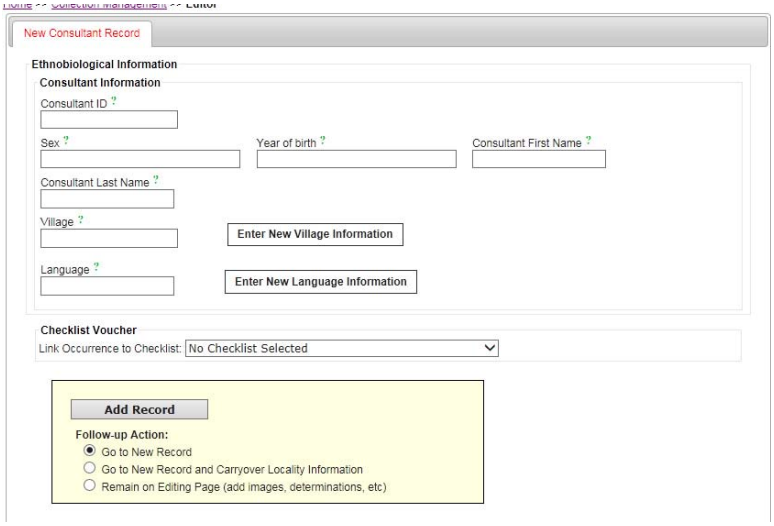
Figure 8: Ethnobiological Data Entry from a Specimen Record



3.b Ethnobiological information: Table-by-table presentation

Consultant table: Each native speaker consultant on a project should be assigned an ID or Code by the project director. This will facilitate keeping consultants anonymous either if they so desire of if at some point it becomes necessary. This ID is entered in the Consultant Information section of a specimen record (first box in fig. 8 in the Ethnobiological Information section of the template). If the consultant does not have an ID, DEMCA will generate a unique and permanent ID once the personal data is entered into the Consultant Date Entry Form. Note that DEMCA only allows entry of a Consultant Code (ID) in the specimen record (fig. 8) if that Code is already in the Consultant table, a project-level database of all personnel. If a contributor tries to enter a Consultant Code in the specimen record and there is no such Code in the Consultant table, then the person entering data is prompted to "Enter New Consultant Information". The same individual entering data may of course "preempt" the prompt by initially clicking on the "Enter New Consultant Information" or creating a Consultant table from the Data Editor Control Panel in beginning the project. The Consultant Data Entry Form is found in figure 9.

Figure 9: Consultant Data Input Form



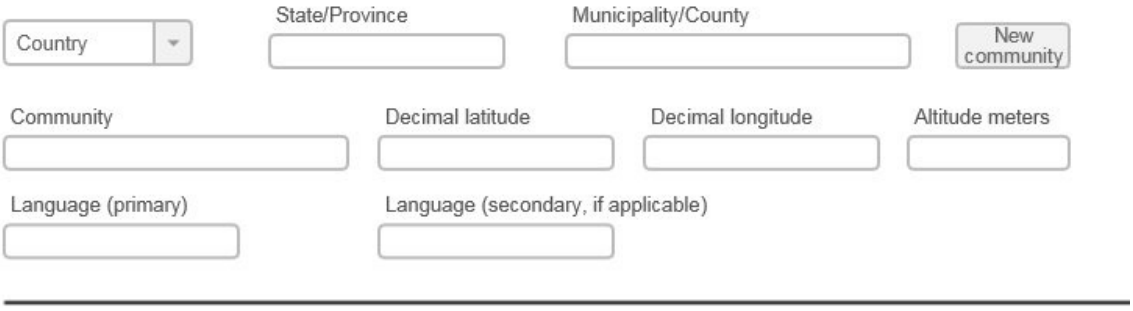
The preceding should be mostly self-explanatory. Note that by using a Consultant Code all personnel data may be kept confidential.

As the proposal for a Level II grant was being developed Amith decided that it would be beneficial to use the IMDI (Isle Meta data Initiative) schema for the Consultant table. A description of IMDI can be found at (https://tla.mpi.nl/imdi-metadata/). This schema is used for endangered language documentation as the standard shared by most archives for endangered language data (e.g., Archive of the Indigenous Languages of Latin American, U. Texas, and Endangered Language Archive, School of Oriental and African Studies, London). Its metadata scheme is well thought out and vetted through use by many researchers and archives. Its future implementation in Symbiota software, initially through DEMCA site development, will hopefully provide the foundation for a clear strategy to incorporate ethnobiological data in biological research and to serve as a bridge between the (ethno)biological and endangered language research community.

Village table: As with Consultant Code, no village name may be entered unless this village is already listed in a Village table (fig. 10). The village database table may be accessed directly from the Data Editor Control Panel (fig. 6), from a specimen record entry form (fig. 8) or from the Consultant Data Entry Form (fig. 9, fourth line). In regard to the latter, if the person entering data attempts to enter a village in the Consultant Table (fig. 9) that is not already registered in the Village/Community table (fig. 10 is the interface for data entry of the latter) he or she will

be prompted to enter this village in the proper Village/Community table. Again, the user can preempt this "error" message by either clicking on Enter New Village Information beforehand if the Community/Village Data table had not been populated earlier in the project. Symbiota has its own built-in geographic reference table. If needed this will be enhanced by data in the Getty Thesaurus of Geographic Names (http://www.getty.edu/research/tools/vocabularies/tgn/). Yes as many of the smallest localities may be missing from both sources, DEMCA will build up a list of controlled geographic localities through depositor contributions and reference to the http://en.mexico.pueblosamerica.com/ website (for Mexico). Each community will be associated with one or, very rarely, two native languages (colonial languages are not listed in this table).

Figure 10: Community/Village Data Input Form

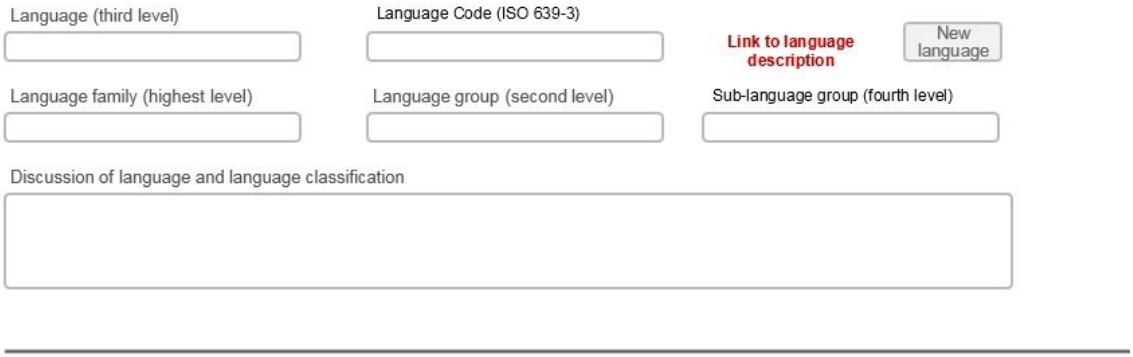


The Decimal latitude and Decimal longitude will permit mapping of all villages for which ethnobiological information is present in the DEMCA database. Likewise the geographic distribution of languages for which information is present will also be possible. In the event that two Indigenous languages are spoken in a community, both may be entered (last line in the input form above).

Language table: Comparative work on ethnobiological nomenclature and classification requires references to the language in which the nomenclature is used. This is not a trivial problem: There is great disagreement among both native speakers and scholars as to the boundaries and names of any given language. Common terms, such as "Nahuatl" and "Mixtec" are highly problematic as these terms are better considered language groups, if not family or subfamilies. At attempt at creating a controlled vocabulary, ISO 639-3, has proven to be inadequate in many cases. The attempt to resolve this problem DEMCA will use the following Language Input form (fig. 11). Again, the Language Input form is accessible from the Data Entry Control Panel (figure 6), from the Consultant data input form (fig. 9) or the Village/Community input screens (fig. 10, note that this Enter New Language Information tab was mistakenly not included in the fig. 10 wireframe).

A basic requirement of language data is that it be discoverable and contextualized. In many ways analogies from biological data is useful. For language data we know the "terminal taxa", which may be equated to the village community. That is, a language is best identified by the community in which it is spoken. Even very low level "languages" such as Yoloxóchitl Mixtec, which comprises only four communities, manifests important intercommunity variation. If the community is the terminal taxon the highest level taxon would be the language family, in this case Otomanguean. The problem is creating a hierarchical structure such as that found with plants which in a simple progression progresses from species (terminal taxon) > section > genus > tribe > family > order.

Fig. 11: Language Data Input Form



The Language table will be developed through careful discussion among experts. The language that will appear in both the Consultant and Community/Village tables is "Language (second level)"; further specification will be available given that Consultants and Vernacular Names will be linked to specific communities, when necessary effectively a language sub-group. Note, finally, that the second and highest levels are in effect similar to terms such as Romance (second level) and Indo-European (highest level).

The greatest problem with "Language" is that there is extensive disagreement as to how languages should be delimited. One scholar (p.c.) considers Nahuatl a single language with many variants or dialects; others consider that Nahuatl is a language group with up to forty different languages. This creates difficulties for language-based searches. One solution is to require all language data to be tagged with an ISO 639-3 code even though many linguists perceive these codes as erroneous representations of language groups. Another, less viable solution, would be to impose a taxonomy and controlled vocabulary. Again, this might meet with resistance. A recent idea has been to associate each taxonomy, i.e., the data in the Language table, to be associated with a researcher and then looking into mapping across taxonomies. These issues will be resolved in a potential Level II grant.

Vernacular name: Although Vernacular name does appear in Darwin Core, it is insufficiently resolved to facilitate research on this topic. There are various reasons for this (each of which is treated in turn below):

- vernacular names are not accompanied by either the parse (morphological analysis) or gloss (meaning of the terms component morphemes);
- most facets of vernacular names (semantics, morphology of the terms, potential calques) that could be used for comparative analysis are not presented
- the language of the vernacular names (e.g., "Mixtec," Nahuatl") is insufficiently differentiated (see discussion of language above)
- the spelling of vernacular names is not constrained allowing proliferation of errors that precludes discovery.
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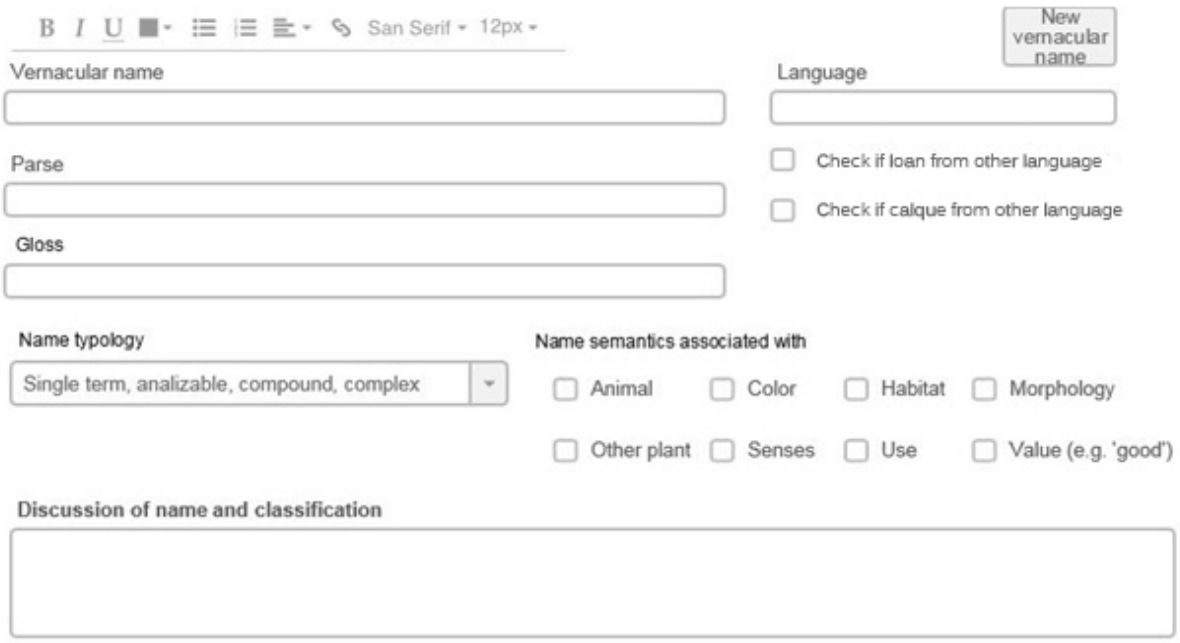
These points and how they are resolved in DEMCA are treated below.

Fig. 12: Vernacular name data entry form



In regard to analysis of vernacular names, these will be accompanied by a parse (i.e., a morpheme-separated representation) and a gloss (a translation to a language such as Spanish or English). A series of check boxes will be available to describe the semantics of the native term (e.g., does the plant name contain an animal name, a color term, a habitat, etc.). The typology will be used to describe the lexeme (is it analyzable or basic, etc.). Finally, users will be able to establish links among calques: words from different languages that have the same meaning but are not word loans. For example, Nahuatl *pi:na:wistli* ('shame') and Yoloxóchitl Mixtec *ti*^{1}*ka*^{4}*an*^{4} *(*'shame animal') manifest a shared semantics. They apply to Solifugue and Amblypygi, both of which are thought to bring shame to the person that comes across them. Apart, then, from direct loan words (tortilla used in English, or Totonac xompepe, 'cockroach' used in Northern Puebla Nahuatl) the shared semantics of terms (and indeed, shared beliefs about biotaxa, such as that black cats are bad luck) in different languages often yields important evidence on cultural contact, as do direct loan words. Any hit on an Indigenous name will, should Level II be funded, allow the user to click on several tabs: (a) reveal cognates; (b) reveal calques; (c) reveal shared cultural beliefs.

Any search and analysis of vernacular names must accurately record the language in which the name is used. By linking the language table to the vernacular name table (upper right corner on the Vernacular name data entry form) a relatively complete description of the language is linked to each vernacular name.

At first it was thought important to standardize the orthography of vernacular names *and* allow for linking cognate sets in different dialects. For example, it was assumed that the Vernacular name table will standard the spelling of *mo:so:tl* (a term found throughout Nahuatl languages, often for *Bidens* spp. (Asteraceae). Note, however, that the cognate form in Sierra Nororiental de Puebla Nahuatl is *mo:so:t*. The difference between the two forms reflects a significant historical development and each must be entered as a regional term and the fuctionality of discovering and displaying cognates must be developed.

A different problem emerges when researchers disagree be it on orthography or on phonetics and phonology. For example, let us say that there are two adjacent Totonac villages that speak variants that are very, very close. One researcher, in village A, hears laryngealization in a word and another research, in village B, does not. One of the two researchers might be wrong, or perhaps there is a difference in laryngealization between the variant in village A and in village B. Standardization would by force select one of the two as "correct" without adequate evidence; or it might obfuscate important intervillage differences.

To resolve this problem, future iterations of DEMCA will borrow a method from biology: Each name will be accompanied by or qualified by an "Authority", i.e,. the person who suggested the term. So just as a plant has genus, species, and authority (e.g, *Cissus microcarpa* Vahl) an indigenous name will be linked to a researcher, e.g., *mo:so:t* Amith. If another researcher did not hear the vowel length and wrote *mosot*, this would be registered under his or her name.

The difficulty then would become one of discovering cognates. This would be accomplished in any of the following ways:

- In entering an Indigenous name the data provider might note a cognate and establish a suggested link (e.g., between *tomakihli* and *tomakilit*)
- Subsequent users might note cognates and suggest links as cognates
- DEMCA/Symbiota will develop an algorithm to discover and suggest cognates using Levenshtein distance between strings entered by users.

Summary:

The Symbiota program, designed for the exchange of biological specimen and observation data, has proven to be extremely useful as a foundation for a web-based presentation of ethnobiological data. However, this data needs to be organized in a way that will both ensure comparability across projects and easy discovery. The viability of the structure presented in the preceding pages can only be evaluated with the implementation and repeated use of a functional website a goal that is planned for the Level II grant.

4. DEMCA will be project based and open to "deposits" from both researchers and communities who wish to document ethnobiological knowledge in Mexico and Central America

DEMCA is conceived of as an interactive workspace for collaboration, research, and project development among diverse potential stakeholders. DEMCA allows for the integration of projects that may be researcher-, institution-, or community based. The projects are each administered separately, through a common portal, software, and database structure. Figure 11 shows how each project is displayed on the user interface

Fig. 13: Project-based organization of data in DEMCA

Figure 13 shows the entry page for searches. Users may select to be presented with only specimen- or observation-based datasets. Or they may open the Specimens & Observations tab and be presented with all projects within

DEMCA (in this case three specimen-based sets and one based on observations). Users may select to search any one or several project datasets. In the future DEMCA will be enhanced to present the option of only searching for projects or records that deal with a given language or culture or that contain audiovisual materials on traditional ecological knowledge.

The importance of the project based approach is that it creates the opportunity for continual integration of new material and allows each project manager or community leader a certain degree of autonomy in content management while providing all with powerful tools for content management.

One of the innovative goals of DEMCA is to provide a web portal to coordinate activities among (1) Indigenous communities and researchers, (2) linguists and anthropologists working in a language community eager to document their own natural environment and traditional ecological knowledge; and (3) biologists wishing to help identify and receive specimens from the communities involved in the project. To accomplish this it is necessary to have a highly qualified team of Indigenous biologists working in close collaboration with communities to document local natural history knowledge. An important facet of this coordination is the creation of a photographic archive of local flora. Amith has worked with native speakers to teach them digital photography with excellent results, as witness the following two photos. An appendix shows an early draft of a field guide produced by two Indigenous biologists for the Totonac community of Zongozotla.

The preceding picture of *Stanhopea dodsoniana* Salazar & Soto Arenas (Orchidaceae) was taken by a Osbel López, Totonac speaking consultant from Zongozotla who was hired to work with Mariano Gorostiza, another native speaker, of Nahuat, to document the flora and ethnobiological knowledge of Zongozotla, the home village of López. Gorostiza, has been working with Amith to document the floristics of the Sierra Nororiental de Puebla, and as mentioned in the previous report, has become an excellent field photographer (see photo below, of *Zuelania guidonia* (Sw.) Britton & Mill [Salicaceae]).

).

At the beginning of their collaboration, Gorostiza was the photographer and López the ethnobiological researcher, taking notes on Totonac nomenclature, classification, and use. However, several months into the project Amith noticed that López was now taking about half of the photograph, of outstanding quality. In ten months of part-time work the two native speakers, each speaking a different language, have created a portfolio of Zongozotla Totonac ethnobotanical knowledge. They have noted 589 Totonac names and have collected and photographed 493 of these. There is immense community interest and after a recent interview on the local radio station, community members would approach López on the street and offer information on plant nomenclature, classification and use.

The photos, the skills that López and Gorostiza have learned in ethnobiological research, their ability to write their own language accurately and the strong community interest in documenting highly endangered traditional ecological knowledge provide an immense, untapped resource for biological and ethnobiological research. This resource is untapped for many reasons but a major inhibiting factor is the logistical difficulty of creating linkages among individuals with various skill sets required for a successful community-based ethnobiological research effort. DEMCA can help solve this problem by providing a platform for the exchange of data and analyses.

For example, a community-based team of Indigenous citizen scientists would record their ethnobotanical knowledge in four forms: (1) voucher specimens of the relevant plant; (2) photographs of the plant in situ; (3) digital audio recordings of the plant named; (4) discussions among native national historians in their mother tongue on the plants collected. DEMCA would provide an initial hub for the dissemination to experts of the digital photographs and recordings. With photographs of the quality above immediate determination to species level is possible for some 70–80 percent of collected materials. Most everything would be identified to genus. This preliminary information would enable the routing of physical specimens to the indicated taxonomic expert. Herbaria and taxonomists would be motivated to participate as at minimal cost they would receive vouchers of the photographed material. Herbaria would increase their holdings, often from areas that are poorly explored. Linguists would receive access to native speakers who could, in addition to recording plant names and traditional ecological knowledge, could also respond to particular elicitation requests that would be useful for comparative

study of linguistic variation. Finally DEMCA is now fully capable of producing project-based checklists and a program (such as XSLT) could easily be written to convert the project data and imagery into a pdf field guide of community flora (see Appendix, pp. 17 ff.).

It is this potential for facilitating synergistic collaboration among various groups that constitutes one of the major and most innovative facets of potential DEMCA development and which will be explored in future grant proposals.

Appendix: Field Guide (partial) for Zongozotla, Puebla

Guía de campo de plantas con nombre totonaco

Municipio Zongozotla

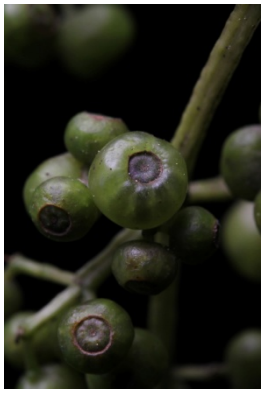
Osbel López Francisco
Mariano Gorostiza Salazar
Jonathan D. Amith
2016-06-15

			**Campanulaceae** *Lobelia laxiflora* Kunth subsp. *laxiflora* **Colecta: 74000** **Descripción:**	**Totonaco de Zongozotla** *Lhakgsta tawan* (hierba que gotea) **Usos:**
			**Convolvulaceae** *Ipomoea dumosa* (Benth) L. O. Williams **Colecta: 74001**	**Totonaco de Zongozotla** *siyu:miyak* (*xa:smantawa*) (bejuco entrelazado [morado]) **Usos:**

		**Convolvulaceae** *Ipomoea batatas* L. **Colecta: 74002**	**Totonaco de Zongozotla** miyak (*xa:snapap*) (bejuco [blanco]) **Usos:**
 		**Musaceae** *Musa ornata* Roxb. **Colecta: 74003**	**Totonaco de Zongozotla** *Tálh:tsih sekgna* ('plátano con semilla') **Usos:**
		**Malvaceae** *Hibiscus uncinellus* DC. **Colecta: 74004**	**Totonaco de Zongozotla** *tán:chachu* (sin interpretación) Usos:

<table>
<tr>
<td colspan="3">  
   </td>
<td>Passifloraceae
Passiflora helleri Peyr.

Colecta: 74005</td>
<td>Totonaco de Zongozotla
xpu:xalhokgwat stáyih (tantu patax)
(Granada de ardilla [patas de pato])

Usos:</td>
</tr>
<tr>
<td>  </td>
<td>  </td>
<td>  </td>
<td>Melastomataceae
Miconia minutiflora (Bonpl.) DC.

Colecta: 74006</td>
<td>Totonaco de Zongozotla
sakgsin kiwi
(árbol dulce)

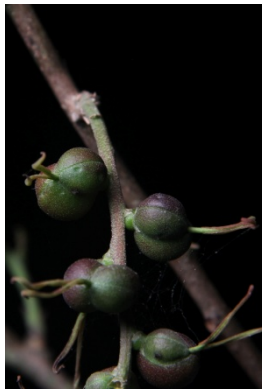
Usos:</td>
</tr>
</table>

			**Malvaceae (ex Tiliaceae)** *Heliocarpus appendiculatus* Turcz. **Colecta: 74007**	**Totonaco de Zongozotla** *cana xu:nik* (*xa:tsatsokg*) (árbol que se pela de corteza marrón [rojo]) **Uso:**
			**Malvaceae (ex Tiliaceae)** *Heliocarpus appendiculatus* Turcz. **Colecta: 74008**	**Totonaco de Zongozotla** *cana xu:nik* (*xa:yipokg*) (árbol que se pela de corteza marrón [gris]) **Usos:**
			**Asteraceae** *Baccharis trinervis* (Lam.) Pers. **Colecta: 74009**	**Totonaco de Zongozotla** *lhicuchana kúchaxa* (hierba tallo de milpa medicinal) **Usos:**

		**Urticaceae** *Cecropia obtusifolia* Bertol. **Colecta: 74010**	**Totonaco de Zongozotla** *akgowa* (sin interpretación) **Usos:**
		**Solanaceae** *Physalis* cf. *gracilis* Miers **Colecta: 74011**	**Totonaco de Zongozotla** *chapú:lhalh* (*xa:pumam*) (sin interpretación)
		**Cannaceae** *Canna tuerckheimii* Kraenzl. **Colecta: 74012**	**Totonaco de Zongozotla** *chikichi* (*onomatopeya*: Sonido de sonaja) **Usos**:

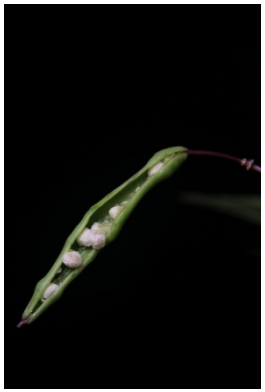
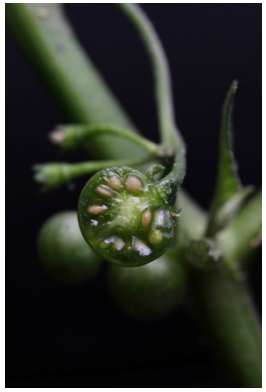
		**Phytolaccaceae** *Rivina humilis* L. . **Colecta: 74013**	**Totonaco de Zongozotla** *lhákgpin tawan* (hierba enchilada) **Usos:**
		**Acanthaceae** Pendiente **Colecta: 74014**	**Totonaco de Zongozotla** *tsís* **Usos:**
		**Papaveraceae** *Phytolacca rivinoides* Kunth & C.D. Bouché **Colecta: 74015**	**Totonaco de Zongozotla** *watlhaklh* (*xa:tsatsokg*) (sin interpretación) **Usos:**

			**Asteraceae** Pendiente **Colecta: 74016**	**Totonaco de Zongozotla** jápat (*xa:tlan*) (Hierba que cruje al masticar [bueno]) **Usos:**
			**Asteraceae** *Baccharis trinervis* (Lam.) Pers. **Colecta: 74017**	**Totonaco de Zongozotla** *kúchaxa* (hierba tallo de milpa) **Usos:**
			**Piperaceae** *Piper auritum* Kunth **Colecta: 74018**	**Totonaco de Zongozotla** *ji:ni* (sin interpretación) **Usos:** No tiene uso alguno. Ningún animal lo come.

				**Malpighiaceae** *Mascagnia vacciniifolia* Nied. **Colecta: 74019**	**Totonaco de Zongozotla** *miyak xanat* (bejuco florescente) **Usos:**
				**Plantanaceae** *Plantanus mexicana* Moric. **Colecta: 74020**	**Totonaco de Zongozotla** *ca:nax kiwi* (sin interpretación árbol) **Usos:**
				**Euphorbiaceae** *Alchornea latifolia* Sw. **Colecta: 74021**	**Totonaco de Zongozotla** *tuxkatat* (sin interpretación) **Usos:**

		**Euphorbiaceae** *Croton draco* Schltdl. & Cham. **Colecta: 74022**	**Totonaco de Zongozotla** *puklh:nán kiwi* (árbol nublado) **Usos:**
		**Malvaceae (ex Bombacaceae)** *Pseudobombax ellipticum* (Kunth) Dugand **Colecta: 74023**	**Totonaco de Zongozotla** *tampokgo* (sin interpretación) **Usos:**
		**Melastomataceae** *Conostegia icosandra* (Sw. in Wikstr.) Urban **Colecta: 74024**	**Totonaco de Zongozotla** *akgswi:lhiwat* (sin interpretación) **Usos:**

		**Leguminosae : Papilionoideae** *Erythrina* sp. **Colecta: 74025**	**Totonaco de Zongozotla** *lha:lhne (xa:tsatsokg)* (gásparo [rojo]) **Usos:**
	 		
		**Convolvulaceae** *Ipomoea indica* (Burm. f.) Merr. . **Colecta: 74026**	**Totonaco de Zongozotla** *miyak (xa:spupuk)* (bejuco [azúl] **Usos:**

			**Cleomaceae** *Cleoserrata speciosa* (Rafinesque) H. H. Iltis **Colecta: 74027**	**Totonaco de Zongozotla** *xkgalhtsa:sat tintsan* (barba blanca de chivo) **Usos:**
			**Solanaceae** *Solanum* sp. (*S. nigrescens* grupo) **Colecta: 74028**	**Totonaco de Zongozotla** *mustálhut* **(**hierba de bolitas en el ápice) **Usos:**
			**Meliaceae** *Trichilia havanensis* Jacq. **Colecta: 74029**	**Totonaco de Zongozotla** *cinax kiwi* (árbol lluvioso) **Usos:**

				**Commelinaceae** *Tradescantia zebrina* Heynh. ex Bosse **Colecta: 74030**	**Totonaco de Zongozotla** *akgasmalh (xa:smantawa)* (hierba de hoja endeble [morada]) **Usos:**
				**Cannabaceae** *Trema micrantha* (L.) Blume **Colecta: 74031**	**Totonaco de Zongozotla** *chi:kgat* (árbol de corteza dura) **Usos:**
				Cactaceae *Rhipsalis baccifera* (J.S. Mueller) Stearn **Colecta: 74032**	**Totonaco de Zongozotla** xtasin chichini (lazo de sol) **Usos:**